Citation:

Saquib N, Natarajan L, Rock CL, Flatt SW, Madlensky L, Kealey S, Pierce JP. The impact of a long-term reduction in dietary energy density on body weight within a randomized diet trial. *Nutr Cancer.* 2008; 60(1):31-8.

PubMed ID: 18444133

Study Design:

Randomized Controlled Trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To evaluate the association between change in energy density and change in weight during a 4-year period.

Inclusion Criteria:

- Female breast cancer survivors
- Enrolled in the Women's Healthy Eating and Living Study (WHEL Study)
- Did not have cancer recurrence or die within the 4-year follow up period
- Diagnosed with cancer between 18-70 years old
- Treated for primary, operable, and invasive stage I, II, or IIIA breast carcinoma
- At study entry were not receiving or scheduled for chemotherapy
- Had no evidence of cancer recurrence after initial treatment

Exclusion Criteria:

- Enrollment in another dietary trial
- Pregnancy
- Receiving estrogen replacement therapy
- Presence of life-threatening medical conditions or diseases

Description of Study Protocol:

Recruitment: Subjects were recruited from 7 sites between March 1995 and November 2000.

Design: Randomized controlled trial

Blinding used: none

Intervention:

- Subject in the intervention group were instructed through telephone counseling, monthly cooking classes, and newsletters to follow a dietary pattern with at least 5 vegetable servings, 16 ounces of vegetable juice (or equivalent vegetable servings), 3 fruit servings, 30 g of fiber (18 g/1,000 kcal), and 15−20% energy from fat.
- Subjects in the control group received printed materials of dietary guidelines from the U.S. Department of Agriculture and the National Cancer Institute and a bimonthly cohort maintenance newsletter with general health and nutrition information.

Statistical Analysis:

- One-way ANOVA: compared age, race, and BMI across tertiles of energy density intakes
- t test: compared total energy intake, physical activity, and body weight values between groups at baseline, 1 yr, and 4 yr
- Mixed model: estimated change in energy density, total plasma carotenoids, total energy intake, physical activity, and body weight over the study follow-up period

Data Collection Summary:

Timing of Measurements:

- Weight and height measured at baseline, 1 year post randomization, 4 years post randomization
- Dietary intake was assessed with four 24-hour dietary recalls and validated with plasma carotenoid concentrations

Dependent Variables:

- Body weight measured during clinic visits in light clothing and no shoes

Independent Variables:

- Energy density calculated using food but excluding beverages
- Dietary intake measured through 24-hour recalls

Control Variables

- Cancer stage (I, II, IIIA)
- Age at study entry (<44, 45−54, 55−64, and ≥65 yr)
- Race (non-Hispanic White, African American, Hispanic, Asian American, and others)
- Education (college graduate vs. nongraduate)
- Employment status (yes, no)
- Marital status (married vs. not married)
- Smoking (current, past, and never)
- Total fruit and vegetable intake (servings/day)
- Percent energy intake from fat/day
- Physical activity (metabolic equivalent task)

Description of Actual Data Sample:

Initial N: 2718 women (1363 control, 1355 intervention)

Attrition (final N): 2146 (1116 control, 1030 intervention) at year 4 (79%)

Age: 26−74 years (mean age = 53.4 ± 8.8 years)

Ethnicity: 85% non-Hispanic White, 4% African American, 3% Asian American, 5%, Hispanic, and 3% other ethnicities

Other relevant demographics: 54% college graduate, 72% employed, 70% married

Anthropometrics mean BMI: 27.3 ± 6.3), 57% overweight or obese. Baseline characteristics did not differ significantly between the randomly assigned control and intervention groups.

Location: various sites within the US: University of California, San Diego; University of California, Davis; Kaiser Permanente Medical Group Inc., Oakland; Kaiser Permanente Center for Health Research, Portland; University of Arizona Cancer Center at Tucson and Phoenix; Northern California Cancer Center (incorporating Stanford University and University of California, San Francisco); and the University of Texas M.D. Anderson Cancer Center, Houston

Summary of Results:

Energy intake, physical activity, and body weight by tertile of baseline dietary energy density (food only)[a]

	Baseline dietary energy density (food only)		
Variable	**Bottom tertile (<1.29 kcal/g)**	**Middle tertile (1.29−1.60 kcal/g)**	**Top tertile (≥1.61 kcal/g)**
Total energy intake (kcal/day)[b]	1,571 ± 12.9	1,698 ± 12.9*	1,874 ± 12.6†
Physical activity (METs/week)[b,c]	1,101 ± 29.6	903 ± 29.4*	637 ± 22.9†
Body weight (kg)[b]	70.1 ± 0.56	72.8 ± 0.55*	76.9 ± 0.55†

[a] n = 2,713 (intervention and control group combined). Reference: bottom tertile; values with different symbols (*, †) are significantly different ($P < 0.05$). 1 kcal = 4.18 kJ. Abbreviation is as follows: METs, metabolic equivalent tasks.
[b] Mean ± standard error of the mean.
[c] Sum of METs assigned as 2 METs/min of casual strolling, 3 METs/min of mild activity or average walking, 4 METs/min of fast walking, 5 METs/min of moderate activity, 6 METs/min of very fast walking, 8 METs/min of strenuous activity.

Changes in energy density, total energy intake, physical activity, and body weight over the study follow-up period: The Women's Healthy Eating and Living (WHEL) Study[a]

			Change	
Factor	**Group**	**Baseline (Mean ± SEM)**	**Yr 1 - Baseline (Mean ± SEM)**	**Yr 4 - Baseline (Mean ± SEM)**

Energy density (food only)	Control	1.49 ± 0.01	−0.03 ± 0.01	0.05 ± 0.01
	Intervention	1.48 ± 0.01	−0.35 ± 0.01**	−0.22 ± 0.01**
Total plasma carotenoids (μmol/l)	Control	2.47 ± 0.04	−0.07 ± 0.03	−0.10 ± 0.04
	Intervention	2.40 ± 0.03	1.59 ± 0.05**	0.94 ± 0.06**
Energy intake (kcal[b]/day)	Control	1,718 ± 11.2	−121 ± 10.7	−152 ± 12.2
	Intervention	1,713 ± 10.9	−115 ± 11.5	−172 ± 16.6
Physical activity (METs/week)[c]	Control	901 ± 24.6	51.2 ± 21.5	24.6 ± 24.5
	Intervention	854 ± 24.3	78.2 ± 21.2	72.2 ± 26.8*
Body weight (kg)	Control	73.3 ± 0.5	0.71 ± 0.11	1.43 ± 0.20
	Intervention	73.3 ± 0.5	−0.05 ± 0.12**	1.77 ± 0.23

[a]Mixed effect models were used to examine difference of change between groups from baseline.
*$P<0.05$
**$P<0.0001$: computed for testing Group × Time interaction for each variable. Abbreviations are as follows: SEM, standard error of the mean; METs, metabolic equivalent tasks.
[b]1 kcal = 4.18 kJ.
[c]Sum of METs assigned as 2 METs/min of casual strolling, 3 METs/min of mild activity or average walking, 4 METs/min of fast walking, 5 METs/min of moderate activity, 6 METs/min of very fast walking, 8 METs/min of strenuous activity.

Other Findings

The mean energy intake was 1,717 kcal/day (SD = 407) [7,184(1,703) kJ/day].

The mean physical activity was 868 metabolic equivalent task (MET)-min/wk (SD = 879).

Intervention participants significantly reduced dietary energy density compared to controls and maintained it over 4 years, both in cross-sectional and longitudinal (both P < 0.0001) analyses.

There was no significant difference between intervention and control groups in energy density, energy intake, physical activity, and body weight at all time points (baseline, year 1, and year 4).

Author Conclusion:

In summary, the intervention in this randomized trial significantly reduced dietary energy density and maintained this change over 4 years. This change in dietary pattern was not associated with a change in energy balance (total energy intake vs expenditure), and it did not result in a meaningful change in weight in free-living individuals. As a strategy to specifically reduce total energy intake, reducing dietary energy density may be a useful component of weight management. However, changing this characteristic of the diet without a targeted reduction in energy intake does not appear to result in either reduced energy intake or weight loss.

Reviewer Comments:

This is a secondary analysis of data generated from a randomized controlled trial. Exposures and outcomes reported in this publication are not primary variables. Authors note that this study was not a random sample of the population; WHEL participants were female breast cancer survivors,

generally White, highly educated and predominantly employed, therefore these results may not be generalizable to the population at large.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes

3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	Yes
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes

6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	Yes
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	Yes
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes

8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes